Hydrologic Model Manager

Short Name	MIKE 11 RR
Long Name	MIKE 11 Rainfall Runoff
Description	
Model Type	The MIKE 11 RR model is a continuous precipitation-runoff model of the deterministic, lumped, conceptual type. It includes simulation of snowmelt in different altitude zones within the catchment. The rainfall-runoff module of MIKE 11 also includes event-based models based on the SCS and other loss models in combination with unit hydrograph methods.
Model Objectives	The MIKE 11 RR model is applied for: - general hydrological analysis - flood forecasting (usually in combination with the hydrodynamic model of MIKE 11) - extension of streamflow records - prediction of low flows
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Model Structure	: Since the first development in 1973, MIKE 11 RR has been applied to rural basins in all climatic regions. A special version of the model, the MOUSE RR, is available for urban areas. The model applies for catchment sizes ranging from a few km2 up to 10000 km2. Larger catchments, however, are usually divided in sub-catchments. MIKE 11 RR represents various components of the rainfall-runoff process by continuously accounting for the water content in four different and mutually interrelated storages. Each storage represents different physical elements of the catchment. MIKE 11 RR can therefore be used either for continuous hydrological modelling over a range of flows or for simulating single events. MIKE 11 RR includes a facility for calculating mean areal precipitation by e.g. Thiessen weighting, combining daily and N-hourly data. Using precipitation, potential evaporation, and temperature as input, the model simulates: - Snow accumulation and melting. The catchment may be sub-divided into smaller zones with separate snow storage calculation in each zone. Using separate temperature and precipitation in each zone, the snow accumulation and melting is calculated considering also the heat contribution from rainfall, re-freezing of liquid water, area coverage depending on the snow storage, redistribution of snow to lower zones (avalanches), etc. - Interception is described by the surface storage, retaining the initial precipitation. - Evapotranspiration is taken from the surface storage at potential rate and subsequently from the root zone at a rate that depends on the soil moisture content. - Infiltration. Excess rainfall is divided into infiltration and overland flow, depending on the soil moisture content in the root zone. - Overland flow is assumed to be proportional to the excess rainfall and vary linearly with the moisture content in the root zone. - Interflow is assumed to be proportional to the moisture content of the surface storage and vary linearly with the moisture content in the root zone. - Overland flow and interflow are routed through two linear reservoirs in series.

	- Groundwater recharge. The amount of the infiltration, which recharges the groundwater, depends on the soil moisture content in the root zone. - Baseflow is calculated as outflow from the groundwater storage, acting as a linear reservoir. The groundwater storgae may be divided in two separate storages, representing a slow and a faster recession. - Capillary flux may be taken into account. This is calculated from the depth to the groundwater table and the relative moisture content in the root zone. - Irrigation and groundwater abstraction may be taken into account.
Interception	
Groundwater	
Snowmelt	
Precipitation	
Evapo-transpiration	
Infiltration	
Model Paramters	MIKE 11 RR uses 9 basic parameters, characterizing the storage capacities and the different flow components. These parameters are sufficient for most model applications. Additional parameters are applied to the advanced modelling of snow, irrigation and groundwater conditions.
Spatial Scale	In MIKE 11 RR the catchment may be decomposed into a network of homogeneous sub-catchments, each having individualized parameters and processes.
Temporal Scale	MIKE 11 RR simulations may be carried out using time steps varying from 1 minute to 1 day. Usually a time step corresponding to the precipitation data is applied.
Input Requirements	The required time series, with a constant or varying time interval between values, are mentioned below along with the recommended range of frequency. 3 to 5 years of data should be available for calibration and a few additional years for validation of the model. The time series are: - precipitation (1 minute to 1 day) - potential evaporation (1 day to 1 month) - temperature (if snowmelt is included) (1 day) - streamflow data for calibration (1 minute to a few hours)
Computer Requirements	A standard PC with Windows 95/98/NT.
Model Output	MIKE 11 RR produces the following output time series with user specified time intervals: - catchment runoff - flow components, i.e. overland flow, interflow, baseflow, snow melt, recharge etc. - storage components, i.e. surface storage, soil moisture content in the root zone, groundwater storage, snow storage etc.
Parameter Estimatn Model Calibrtn	The model can be calibrated by the user, applying the provided graphical and statistical facilities for comparing simulated and observed flow. MIKE 11 RR also offers a flexible automatic calibration procedure where the user can specify a subset of parameters to be calibrated automatically using various goodness-of-fit measures that focus on different aspects of the hydrograph. Online help is available throughout MIKE 11.
Model Testing Verification	MIKE 11 RR has been extensively tested using split sample and other techniques. Sample data are available and training courses are offered regularly.
Model Sensitivity	Through practical model applications over the last decades, additional features have occasionally been included to take special, local conditions into account. An example is the influence of the rivers in Bangladesh on groundwater conditions in the delta. The model, however, has been structured so that only the key parameters are required to be specified by the user, whereas other parameters may remain at their default value.

Model Reliabiity	MIKE 11 RR is widely accepted worldwide and has proved its reliability through numerous applications under all climatic conditions.
Model Application	MIKE 11 RR has been applied to a wide range of hydrological/hydrodynamic design and planning projects, either as a stand alone modelling tool or in combination with the MIKE 11 river network model. Applications include flood forecasting, flood management, flood frequency analysis, prediction of low flows, irrigation management, among others.
Documentation	MIKE 11 RR user documentation in the form of a Technical Reference and Model Documentation and User Manual. MIKE 11 RR model applications are documented in technical reports and in conference and journal publications. In addition, DHI offers a comprehensive system of technical support through its dedicated Software Support Centre. 24 hour assistance from DHI's highly trained technical staff can be obtained through our Software Support Centre via telephone hotline, fax or the Internet (software@dhigroup.com). As a part of License Service Agreements DHI software users are updated regularly with software developments via newsletters and Internet broadcasts.
Other Comments	
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